

WHAT IS CLAIMED IS:

1 1. A method for restoring a virtual path in an optical network, the method
2 comprising:

3 identifying a plurality of nodes with resources, wherein said nodes with
4 resources are ones of said nodes having a resource necessary to support
5 said virtual path; and
6 identifying an alternate physical path, said alternate physical path comprising
7 ones of said nodes with resources.

1 2. The method of claim 1, further comprising:

2 restoring said virtual path using said alternate physical path.

1 3. The method of claim 2, wherein said restoring is done by
2 configuring said alternate physical path by establishing a communication
3 connection between said ones of said nodes with resources; and
4 provisioning said virtual path over said alternate physical path.

1 4. The method of claim 2, further comprising:

2 detecting a failure in said virtual path;
3 said detection of said failure is done by receiving a failure message packet;
4 said virtual path is provisioned on a physical path between a first and a second
5 node of said optical network;
6 said optical network comprises said nodes;
7 each one of said nodes is coupled to at least one another of said nodes by a
8 plurality of optical links;
9 said physical path between said first and said second node comprises a
10 plurality of intermediate nodes; and
11 each one of said nodes is coupled to at least one another of said nodes in a
12 mesh topology.

1 5. The method of claim 4, wherein said restoring of said virtual path is
2 completed in less than 2 seconds.

1 6. The method of claim 4, wherein said restoring of said virtual path is
2 completed in less than 250 milliseconds.

1 7. The method of claim 4, wherein said first node receives said failure
2 message packet.

1 8. The method of claim 7, further comprising:
2 (i) changing a state of said virtual path to restoring;
3 (ii) identifying an adjacent node with required bandwidth for said
4 virtual path;
5 (iii) forwarding a resource request packet to said adjacent node with
6 required bandwidth for said virtual path;
7 (iv) waiting for a resource response packet for a predetermined time
8 interval; and
9 if said resource response packet is not received within said predetermined
10 time interval,
11 repeating steps (ii) – (iv) for a predefined threshold times.

1 9. The method of claim 8, further comprising:
2 if said resource response packet is not received within said predefined
3 threshold time,
4 generating a network alarm.

1 10. The method of claim 8, further comprising:
2 if said resource response packet is received with at least one error,
3 waiting until responses to all resource request packets are received; and
4 if said resource response packet is received with no errors,
5 determining if a list of allocated ports in said resource response packet
6 is valid.

1 11. The method of claim 10, further comprising:
2 if said list of allocated port is valid,
3 provisioning said virtual path on said allocated ports; and
4 if said list of allocated ports is invalid,
5 generating a network alarm.

1 12. The method of claim 10, further comprising:
2 if responses to all resource request packets are received with at least one error,
3 generating a network alarm.

1 13. The method of claim 9, wherein said predetermined time interval and
2 predefined threshold are dynamically calculated by said network.

1 14. The method of claim 4, wherein one of said intermediate nodes
2 receives said failure message.

1 15. The method of claim 14, further comprising:
2 changing a state of said virtual path to down;
3 forwarding said failure message to adjacent nodes comprising said virtual
4 path;
5 initiating a timer for receiving a response to said forwarded failure message;
6 if said timer expires before said response to said forwarded failure message is
7 received,
8 releasing resources of said virtual path; and
9 if said response to said forwarded failure message is received before said timer
10 expires,
11 stopping said timer, and
12 releasing resources of said virtual path.

1 16. The method of claim 4, wherein said second node receives said failure
2 message.

1 17. The method of claim 16, further comprising:
2 acknowledging said failure message;
3 changing a state of said virtual path to down; and
4 releasing resources of said virtual path.

1 18. The method of claim 18, wherein one of said intermediate nodes
2 receives said resource request packet.

1 19. The method of claim 18, further comprising:
2 if said resource request packet includes at least one error,
3 copying said resource request packet to a first resource response
4 packet,
5 decrementing a hop count field in said first resource response packet,
6 adding an error code to said first resource response packet, and
7 responding with said first resource response packet; and
8 if said resource request packet includes no errors,
9 allocating a resource to said virtual path,
10 incrementing a hop count field in said resource request packet,
11 forwarding said resource request packet to an adjacent node having a
12 resource necessary to support said virtual path, and
13 waiting for a second resource response packet from said adjacent node.

1 20. The method of claim 19, further comprising:
2 if said second resource response packet is not received within a predetermined
3 time interval,
4 releasing said resource allocated to said virtual path, and
5 forwarding a negative acknowledgment to said first node.

1 21. The method of claim 19, further comprising:
2 if said second resource response packet is received with at least one error,
3 releasing said resources allocated to said virtual path,
4 decrementing a hop count field in said second resource response
5 packet, and
6 forwarding said second resource response packet to said first node; and
7 if said second resource response packet is received with no errors,
8 determining if said second resource response packet includes a valid
9 list of a plurality of ports.

1 22. The method of claim 21, further comprising:
2 if said list of said plurality of ports is invalid,
3 releasing resources allocated to said virtual path, and
4 forwarding a negative acknowledgement to said first node;
5 if said list of said plurality of ports is valid,
6 determining if said plurality of ports is available;
7 if said plurality of ports is available,
8 assigning said plurality of ports to said virtual path, and
9 updating said virtual path information in a node database;
10 if said plurality of ports is not available,
11 adding an error code to said second resource response packet;
12 decrementing a hop count field in said second resource response packet; and
13 forwarding said second resource response packet to said first node.

1 23. The method of claim 18, further comprising:
2 if a state of said virtual path is one of ‘restoring’ and ‘deleting’,
3 copying said resource request packet to said first resource response
4 packet,
5 decrementing said hop count field in said first resource response
6 packet,
7 adding an error code of to said first resource response packet, and
8 responding with said first resource response packet.

1 24. The method of claim 8, wherein said second node receives said
2 resource request packet.

1 25. The method of claim 24, further comprising:
2 if said resource request packet includes invalid information,
3 copying said resource request packet to a third resource response
4 packet,
5 decrementing a hop count field in said third resource response packet,
6 adding an error code to said third resource response packet, and
7 responding with said third resource response packet; and
8 if said resource request packet includes valid information,
9 determining if a resource is available for said virtual path.

1 26. The method of claim 25, further comprising:
2 if said resource is available for said virtual path,
3 copying said resource request packet to said third resource response
4 packet,
5 allocating said resource to said virtual path,
6 updating said virtual path information in a node database,
7 decrementing a hop count field in said third resource response packet,
8 adding a list of a plurality of ports to said third resource response
9 packet, and
10 responding with said third resource response packet.

1 27. The method of claim 25, further comprising:
2 if said resource is not available for said virtual path,
3 copying said resource request packet to said third resource response
4 packet,
5 decrementing said hop count field in said third resource response
6 packet,
7 adding an error code to said third resource response packet, and
8 responding with said third resource response packet.

1 28. The method of claim 24, further comprising:
2 if a state of said virtual path is one of ‘restoring’ and ‘deleting’,
3 copying said resource request packet to said third resource response
4 packet,
5 decrementing said hop count field in said third resource response
6 packet,
7 adding an error code to said third resource response packet, and
8 responding with said third resource response packet.

1 29. A network element configured to restore a virtual path in an optical
2 network, the network element comprising:
3 a processor;
4 a memory coupled to said processor; and
5 a network interface coupled to said processor; said processor configured to
6 identify a plurality of nodes with resources, wherein said nodes with
7 resources are ones of said nodes having a resource necessary to
8 support said virtual path, and
9 identify an alternate physical path, said alternate physical path
10 comprising ones of said nodes with resources.

1 30. The network element of claim 29, wherein said processor is further
2 configured to
3 restore said virtual path using said alternate physical path.

1 31. The network element of claim 29, wherein said processor is further
2 configured to
3 configure said alternate physical path by establishing a communication
4 connection between said ones of said nodes with resources; and
5 provision said virtual path over said alternate physical path.

1 32. The network element of claim 29, wherein said processor is further
2 configured to
3 detect a failure in said virtual path;
4 said detection of said failure is done by receiving a failure message packet;
5 said virtual path is provisioned on a physical path between a first and a second
6 node of said optical network;
7 said optical network comprises said nodes;
8 each one of said nodes is coupled to at least one another of said nodes by a
9 plurality of optical links;
10 said physical path between said first and said second node comprises a
11 plurality of intermediate nodes; and
12 each one of said nodes is coupled to at least one another of said nodes in a
13 mesh topology.

1 33. The network element of claim 32, wherein said processor is further
2 configured to restore said virtual path in less than 2 seconds.

1 34. The network element of claim 32, wherein said processor is further
2 configured to restore said virtual path in less than 250 milliseconds.

1 35. The method of claim 32, wherein
2 said network element is configured as said first node; and
3 said network element receives said failure message packet.

1 36. The network element of claim 35, wherein said processor is further
2 configured to
3 (i) change a state of said virtual path to restoring;
4 (ii) identify an adjacent node with required bandwidth for said
5 virtual path;
6 (iii) forward a resource request packet to said adjacent node with
7 required bandwidth for said virtual path;
8 (iv) wait for a resource response packet for a predetermined time
9 interval; and

10 (v) if said resource response packet is not received within said
11 predetermined time interval,
12 repeat steps (ii) – (iv) for a predefined threshold times.

1 37. The network element of claim 36, wherein said processor is further
2 configured to

3 if said resource response packet is not received within said predefined
4 threshold time,
5 generate a network alarm.

1 38. The network element of claim 36, wherein said processor is further
2 configured to

3 if said resource response packet is received with at least one error,
4 wait until responses to all resource request packets are received; and
5 if said resource response packet is received with no errors,
6 determine if a list of allocated ports in said resource response packet is
7 valid.

1 39. The network element of claim 38, wherein said processor is further
2 configured to

3 if said list of allocated port is valid,
4 provision said virtual path on said allocated ports; and
5 if said list of allocated ports is invalid,
6 generate a network alarm.

1 40. The network element of claim 38, wherein said processor is further
2 configured to

3 if responses to all resource request packets are received with at least one error,
4 generate a network alarm.

1 41. The network element of claim 39, wherein said predetermined time
2 interval and predefined threshold are dynamically calculated by said network.

1 42. The network element of claim 4, wherein
2 said network element is configured as one of said intermediate nodes, and
3 said network element receives said failure message.

1 43. The network element of claim 42, wherein said processor is further
2 configured to

3 change a state of said virtual path to down;
4 forward said failure message to adjacent nodes comprising said virtual path;
5 initiate a timer for receiving a response to said forwarded failure message;
6 if said timer expires before said response to said forwarded failure message is
7 received,
8 release resources of said virtual path; and
9 if said response to said forwarded failure message is received before said timer
10 expires,
11 stop said timer, and
12 release resources of said virtual path.

1 44. The network element of claim 32, wherein said processor is further
2 configured to

3 said network element is configured as said second node, and
4 said network element receives said failure message.

1 45. The network element of claim 44, wherein said processor is further
2 configured to

3 acknowledge said failure message;
4 change a state of said virtual path to down; and
5 release resources of said virtual path.

1 46. The network element of claim 36, wherein
2 said network element is configured as one of said intermediate nodes, and
3 said network element receives said resource request packet.

1 47. The network element of claim 46, wherein said processor is further
2 configured to
3 if said resource request packet includes at least one error,
4 copy said resource request packet to a first resource response packet,
5 decrement a hop count field in said first resource response packet,
6 add an error code to said first resource response packet, and
7 respond with said first resource response packet; and
8 if said resource request packet includes no errors,
9 allocate a resource to said virtual path,
10 increment a hop count field in said resource request packet,
11 forward said resource request packet to an adjacent node having a
12 resource necessary to support said virtual path, and
13 wait for a second resource response packet from said adjacent node.

1 48. The network element of claim 47, wherein said processor is further
2 configured to
3 if said second resource response packet is not received within a predetermined
4 time interval,
5 release said resource allocated to said virtual path, and
6 forward a negative acknowledgment to said first node.

1 49. The network element of claim 47, wherein said processor is further
2 configured to
3 if said second resource response packet is received with at least one error,
4 release said resources allocated to said virtual path,
5 decrement a hop count field in said second resource response packet,
6 and
7 forward said second resource response packet to said first node; and
8 if said second resource response packet is received with no errors,
9 determine if said second resource response packet includes a valid list
10 of a plurality of ports.

1 50. The network element of claim 49, wherein said processor is further
2 configured to

3 if said list of said plurality of ports is invalid,
4 release resources allocated to said virtual path, and
5 forward a negative acknowledgement to said first node;
6 if said list of said plurality of ports is valid,
7 determine if said plurality of ports is available;
8 if said plurality of ports is available,
9 assign said plurality of ports to said virtual path, and
10 update said virtual path information in a node database;
11 if said plurality of ports is not available,
12 add an error code to said second resource response packet;
13 decrement a hop count field in said second resource response packet; and
14 forward said second resource response packet to said first node.

1 51. The network element of claim 46, wherein said processor is further
2 configured to

3 if a state of said virtual path is one of ‘restoring’ and ‘deleting’,
4 copy said resource request packet to said first resource response
5 packet,
6 decrement said hop count field in said first resource response packet,
7 add an error code of to said first resource response packet, and
8 respond with said first resource response packet.

1 52. The network element of claim 36, wherein
2 network element is configured as said second node, and
3 said network element receives said resource request packet.

1 53. The network element of claim 52, wherein said processor is further
2 configured to

3 if said resource request packet includes invalid information,
4 copy said resource request packet to a third resource response packet,
5 decrement a hop count field in said third resource response packet,

6 add an error code to said third resource response packet, and
7 respond with said third resource response packet; and
8 if said resource request packet includes valid information,
9 determine if a resource is available for said virtual path.

1 54. The network element of claim 53, wherein said processor is further
2 configured to
3 if said resource is available for said virtual path,
4 copy said resource request packet to said third resource response
5 packet,
6 allocate said resource to said virtual path,
7 update said virtual path information in a node database,
8 decrement a hop count field in said third resource response packet,
9 add a list of a plurality of ports to said third resource response packet,
10 and
11 respond with said third resource response packet.

1 55. The network element of claim 53, wherein said processor is further
2 configured to
3 if said resource is not available for said virtual path,
4 copy said resource request packet to said third resource response
5 packet,
6 decrement said hop count field in said third resource response packet,
7 add an error code to said third resource response packet, and
8 respond with said third resource response packet.

1 56. The network element of claim 52, wherein said processor is further
2 configured to
3 if a state of said virtual path is one of ‘restoring’ and ‘deleting’,
4 copy said resource request packet to said third resource response
5 packet,
6 decrement said hop count field in said third resource response packet,
7 add an error code to said third resource response packet, and
8 respond with said third resource response packet.

1 57. A computer system for restoring a virtual path in an optical network,
2 said computer system comprising:

3 means for identifying a plurality of nodes with resources, wherein said nodes
4 with resources are ones of said nodes having a resource necessary to
5 support said virtual path; and
6 means for identifying an alternate physical path, said alternate physical path
7 comprising ones of said nodes with resources.

1 58. The computer system of claim 57, further comprising:

2 means for restoring said virtual path using said alternate physical path.

1 59. The computer system of claim 57, wherein said restoring is done by
2 means for configuring said alternate physical path by establishing a
3 communication connection between said ones of said nodes with
4 resources; and

5 means for provisioning said virtual path over said alternate physical path.

1 60. The computer system of claim 58, further comprising:

2 means for detecting a failure in said virtual path;
3 said detection of said failure is done by receiving a failure message packet;
4 said virtual path is provisioned on a physical path between a first and a second
5 node of said optical network;

6 said optical network comprises said nodes;

7 each one of said nodes is coupled to at least one another of said nodes by a
8 plurality of optical links;

9 said physical path between said first and said second node comprises a
10 plurality of intermediate nodes; and

11 each one of said nodes is coupled to at least one another of said nodes in a
12 mesh topology.

1 61. The computer system of claim 60, wherein said restoring of said
2 virtual path is completed in less than 2 seconds.

1 62. The computer system of claim 60, wherein said restoring of said virtual
2 path is completed in less than 250 milliseconds.

1 63. The computer system of claim 60, wherein said first node receives said
2 failure message packet.

1 64. The computer system of claim 63, further comprising:
2 (i) means for changing a state of said virtual path to restoring;
3 (ii) means for identifying an adjacent node with required
4 bandwidth for said virtual path;
5 (iii) means for forwarding a resource request packet to said adjacent
6 node with required bandwidth for said virtual path;
7 (iv) means for waiting for a resource response packet for a
8 predetermined time interval; and
9 means for repeating steps (ii) – (iv) for a predefined threshold times if said
10 resource response packet is not received within said predetermined
11 time interval.

1 65. The computer system of claim 64, further comprising:
2 means for generating a network alarm if said resource response packet is not
3 received within said predefined threshold time.

1 66. The computer system of claim 64, further comprising:
2 means for waiting until responses to all resource request packets are received
3 if said resource response packet is received with at least one error; and
4 means for determining if a list of allocated ports in said resource response
5 packet is valid if said resource response packet is received with no
6 errors.

1 67. The computer system of claim 66, further comprising:
2 means for provisioning said virtual path on said allocated ports if said list of
3 allocated port is valid; and
4 means for generating a network alarm if said list of allocated ports is invalid.

1 68. The computer system of claim 66, further comprising:
2 means for generating a network alarm if responses to all resource request
3 packets are received with at least one error.

1 69. The computer system of claim 65, wherein said predetermined time
2 interval and predefined threshold are dynamically calculated by said network.

1 70. The computer system of claim 60, wherein one of said intermediate
2 nodes receives said failure message.

1 71. The computer system of claim 70, further comprising:
2 means for changing a state of said virtual path to down;
3 means for forwarding said failure message to adjacent nodes comprising said
4 virtual path;
5 means for initiating a timer for receiving a response to said forwarded failure
6 message;
7 means for releasing resources of said virtual path if said timer expires before
8 said response to said forwarded failure message is received;
9 means for stopping said timer if said response to said forwarded failure
10 message is received before said timer expires; and
11 means for releasing resources of said virtual path if said response to said
12 forwarded failure message is received before said timer expires.

1 72. The computer system of claim 60, wherein said second node receives
2 said failure message.

1 73. The computer system of claim 72, further comprising:
2 means for acknowledging said failure message;
3 means for changing a state of said virtual path to down; and
4 means for releasing resources of said virtual path.

1 74. The computer system of claim 64, wherein one of said intermediate
2 nodes receives said resource request packet.

1 75. The computer system of claim 74, further comprising:
2 means for copying said resource request packet to a first resource response
3 packet if said resource request packet includes at least one error;
4 means for decrementing a hop count field in said first resource response
5 packet if said resource request packet includes at least one error;
6 means for adding an error code to said first resource response packet if said
7 resource request packet includes at least one error;
8 means for responding with said first resource response packet if said resource
9 request packet includes at least one error;
10 means for allocating a resource to said virtual path if said resource request
11 packet includes no errors;
12 means for incrementing a hop count field in said resource request packet if
13 said resource request packet includes no errors;
14 means for forwarding said resource request packet to an adjacent node having
15 a resource necessary to support said virtual path if said resource
16 request packet includes no errors; and
17 means for waiting for a second resource response packet from said adjacent
18 node if said resource request packet includes no errors.

1 76. The computer system of claim 75, further comprising:
2 means for releasing said resource allocated to said virtual path if said second
3 resource response packet is not received within a predetermined time
4 interval; and
5 means for forwarding a negative acknowledgment to said first node if said
6 second resource response packet is not received within a
7 predetermined time interval.

1 77. The computer system of claim 75, further comprising:
2 means for releasing said resources allocated to said virtual path if said second
3 resource response packet is received with at least one error;
4 means for decrementing a hop count field in said second resource response
5 packet if said second resource response packet is received with at least
6 one error;
7 means for forwarding said second resource response packet to said first node if
8 said second resource response packet is received with at least one
9 error; and
10 means for determining if said second resource response packet includes a valid
11 list of a plurality of ports if said second resource response packet is
12 received with no errors.

1 78. The computer system of claim 77, further comprising:
2 means for releasing resources allocated to said virtual path if said list of said
3 plurality of ports is invalid;
4 means for forwarding a negative acknowledgement to said first node if said
5 list of said plurality of ports is invalid;
6 means for determining if said plurality of ports is available if said list of said
7 plurality of ports is valid;
8 means for assigning said plurality of ports to said virtual path if said plurality
9 of ports is available;
10 means for updating said virtual path information in a node database if said
11 plurality of ports is available;
12 means for adding an error code to said second resource response packet if said
13 plurality of ports is not available;
14 means for decrementing a hop count field in said second resource response
15 packet; and
16 means for forwarding said second resource response packet to said first node.

1 79. The computer system of claim 74, further comprising:
2 means for copying said resource request packet to said first resource response
3 packet if a state of said virtual path is one of ‘restoring’ and ‘deleting’;
4 means for decrementing said hop count field in said first resource response
5 packet if a state of said virtual path is one of ‘restoring’ and ‘deleting’;
6 means for adding an error code of to said first resource response packet if a
7 state of said virtual path is one of ‘restoring’ and ‘deleting’; and
8 means for responding with said first resource response packet if a state of said
9 virtual path is one of ‘restoring’ and ‘deleting’.

1 80. The computer system of claim 64, wherein said second node receives
2 said resource request packet.

1 81. The computer system of claim 80, further comprising:
2 means for copying said resource request packet to a third resource response
3 packet if said resource request packet includes invalid information;
4 means for decrementing a hop count field in said third resource response
5 packet if said resource request packet includes invalid information;
6 means for adding an error code to said third resource response packet if said
7 resource request packet includes invalid information;
8 means for responding with said third resource response packet if said resource
9 request packet includes invalid information; and
10 means for determining if a resource is available for said virtual path if said
11 resource request packet includes valid information.

1 82. The computer system of claim 81, further comprising:
2 means for copying said resource request packet to said third resource response
3 packet if said resource is available for said virtual path;
4 means for allocating said resource to said virtual path if said resource is
5 available for said virtual path;
6 means for updating said virtual path information in a node database if said
7 resource is available for said virtual path;
8 means for decrementing a hop count field in said third resource response
9 packet if said resource is available for said virtual path;
10 means for adding a list of a plurality of ports to said third resource response
11 packet if said resource is available for said virtual path; and
12 means for responding with said third resource response packet.

1 83. The computer system of claim 81, further comprising:
2 means for copying said resource request packet to said third resource response
3 packet if said resource is not available for said virtual path;
4 means for decrementing said hop count field in said third resource response
5 packet if said resource is not available for said virtual path;
6 means for adding an error code to said third resource response packet if said
7 resource is not available for said virtual path; and
8 means for responding with said third resource response packet.

1 84. The computer system of claim 80, further comprising:
2 means for copying said resource request packet to said third resource response
3 packet if a state of said virtual path is one of ‘restoring’ and ‘deleting’;
4 means for decrementing said hop count field in said third resource response
5 packet if a state of said virtual path is one of ‘restoring’ and ‘deleting’;
6 means for adding an error code to said third resource response packet if a state
7 of said virtual path is one of ‘restoring’ and ‘deleting’; and
8 means for responding with said third resource response packet.

1 85. A computer program product for restoring a virtual path in an optical
2 network, encoded in computer readable media, said program product comprising a set
3 of instructions executable on a computer system, said set of instructions configured to
4 identify a plurality of nodes with resources, wherein said nodes with resources
5 are ones of said nodes having a resource necessary to support said
6 virtual path; and

7 identifying an alternate physical path, said alternate physical path comprising
8 ones of said nodes with resources.

1 86. The computer program product of claim 85, wherein said set of
2 instructions is further configured to
3 restore said virtual path using said alternate physical path.

1 87. The computer program product of claim 85, wherein said set of
2 instructions is further configured to
3 configure said alternate physical path by establishing a communication
4 connection between said ones of said nodes with resources; and
5 provision said virtual path over said alternate physical path.

1 88. The computer program product of claim 85, wherein said set of
2 instructions is further configured to
3 detect a failure in said virtual path;
4 said detection of said failure is done by receiving a failure message packet;
5 said virtual path is provisioned on a physical path between a first and a second
6 node of said optical network;
7 said optical network comprises said nodes;
8 each one of said nodes is coupled to at least one another of said nodes by a
9 plurality of optical links;
10 said physical path between said first and said second node comprises a
11 plurality of intermediate nodes; and
12 each one of said nodes is coupled to at least one another of said nodes in a
13 mesh topology.

1 89. The computer program product of claim 88, wherein said set of
2 instructions is further configured to restore said virtual path in less than 2 seconds.

1 90. The computer program product of claim 88, wherein said set of
2 instructions is further configured to restore said virtual path in less than 250
3 milliseconds.

1 91. The method of claim 88, wherein said first node receives said failure
2 message packet.

1 92. The computer program product of claim 91, wherein said set of
2 instructions is further configured to
3 (i) change a state of said virtual path to restoring;
4 (ii) identify an adjacent node with required bandwidth for said
5 virtual path;
6 (iii) forward a resource request packet to said adjacent node with
7 required bandwidth for said virtual path;
8 (iv) wait for a resource response packet for a predetermined time
9 interval; and
10 (v) if said resource response packet is not received within said
11 predetermined time interval,
12 repeat steps (ii) – (iv) for a predefined threshold times.

1 93. The computer program product of claim 92, wherein said set of
2 instructions is further configured to
3 if said resource response packet is not received within said predefined
4 threshold time,
5 generate a network alarm.

1 94. The computer program product of claim 94, wherein said set of
2 instructions is further configured to
3 if said resource response packet is received with at least one error,
4 wait until responses to all resource request packets are received; and

5 if said resource response packet is received with no errors,
6 determine if a list of allocated ports in said resource response packet is
7 valid.

1 95. The computer program product of claim 94, wherein said set of
2 instructions is further configured to
3 if said list of allocated port is valid,
4 provision said virtual path on said allocated ports; and
5 if said list of allocated ports is invalid,
6 generate a network alarm.

1 96. The computer program product of claim 93, wherein said set of
2 instructions is further configured to
3 if responses to all resource request packets are received with at least one error,
4 generate a network alarm.

1 97. The computer program product of claim 88, wherein said
2 predetermined time interval and predefined threshold are dynamically calculated by
3 said network.

1 98. The computer program product of claim 88, wherein one of said
2 intermediate nodes receives said failure message.

1 99. The computer program product of claim 88, wherein said set of
2 instructions is further configured to
3 change a state of said virtual path to down;
4 forward said failure message to adjacent nodes comprising said virtual path;
5 initiate a timer for receiving a response to said forwarded failure message;
6 if said timer expires before said response to said forwarded failure message is
7 received,
8 release resources of said virtual path; and
9 if said response to said forwarded failure message is received before said timer
10 expires,
11 stop said timer, and
12 release resources of said virtual path.

1 100. The computer program product of claim 88, wherein said second node
2 receives said failure message.

1 101. The computer program product of claim 100, wherein said set of
2 instructions is further configured to
3 acknowledge said failure message;
4 change a state of said virtual path to down; and
5 release resources of said virtual path.

1 102. The computer program product of claim 92, wherein one of said
2 intermediate nodes receives said resource request packet.

1 103. The computer program product of claim 92, wherein said set of
2 instructions is further configured to
3 if said resource request packet includes at least one error,
4 copy said resource request packet to a first resource response packet,
5 decrement a hop count field in said first resource response packet,
6 add an error code to said first resource response packet, and
7 respond with said first resource response packet; and
8 if said resource request packet includes no errors,

9 allocate a resource to said virtual path,
10 increment a hop count field in said resource request packet,
11 forward said resource request packet to an adjacent node having a
12 resource necessary to support said virtual path, and
13 wait for a second resource response packet from said adjacent node.

1 104. The computer program product of claim 103, wherein said set of
2 instructions is further configured to
3 if said second resource response packet is not received within a predetermined
4 time interval,
5 release said resource allocated to said virtual path, and
6 forward a negative acknowledgment to said first node.

1 105. The computer program product of claim 103, wherein said set of
2 instructions is further configured to
3 if said second resource response packet is received with at least one error,
4 release said resources allocated to said virtual path,
5 decrement a hop count field in said second resource response packet,
6 and
7 forward said second resource response packet to said first node; and
8 if said second resource response packet is received with no errors,
9 determine if said second resource response packet includes a valid list
10 of a plurality of ports.

1 106. The computer program product of claim 105, wherein said set of
2 instructions is further configured to
3 if said list of said plurality of ports is invalid,
4 release resources allocated to said virtual path, and
5 forward a negative acknowledgement to said first node;
6 if said list of said plurality of ports is valid,
7 determine if said plurality of ports is available;
8 if said plurality of ports is available,
9 assign said plurality of ports to said virtual path, and
10 update said virtual path information in a node database;

11 if said plurality of ports is not available,
12 add an error code to said second resource response packet;
13 decrement a hop count field in said second resource response packet; and
14 forward said second resource response packet to said first node.

1 107. The computer program product of claim 102, wherein said set of
2 instructions is further configured to
3 if a state of said virtual path is one of ‘restoring’ and ‘deleting’,
4 copy said resource request packet to said first resource response
5 packet,
6 decrement said hop count field in said first resource response packet,
7 add an error code of to said first resource response packet, and
8 respond with said first resource response packet.

1 108. The computer program product of claim 92, wherein said second node
2 receives said resource request packet.

1 109. The computer program product of claim 108, wherein said set of
2 instructions is further configured to
3 if said resource request packet includes invalid information,
4 copy said resource request packet to a third resource response packet,
5 decrement a hop count field in said third resource response packet,
6 add an error code to said third resource response packet, and
7 respond with said third resource response packet; and
8 if said resource request packet includes valid information,
9 determine if a resource is available for said virtual path.

1 110. The computer program product of claim 109, wherein said set of
2 instructions is further configured to
3 if said resource is available for said virtual path,
4 copy said resource request packet to said third resource response
5 packet,
6 allocate said resource to said virtual path,
7 update said virtual path information in a node database,
8 decrement a hop count field in said third resource response packet,
9 add a list of a plurality of ports to said third resource response packet,
10 and
11 respond with said third resource response packet.

1 111. The computer program product of claim 108, wherein said set of
2 instructions is further configured to
3 if said resource is not available for said virtual path,
4 copy said resource request packet to said third resource response
5 packet,
6 decrement said hop count field in said third resource response packet,
7 add an error code to said third resource response packet, and
8 respond with said third resource response packet.

1 112. The computer program product of claim 24, wherein said set of
2 instructions is further configured to
3 if a state of said virtual path is one of ‘restoring’ and ‘deleting’,
4 copy said resource request packet to said third resource response
5 packet,
6 decrement said hop count field in said third resource response packet,
7 add an error code to said third resource response packet, and
8 respond with said third resource response packet.